National Aeronautics and
Space Administration

Office of Biological and Physical Research

NASA DEVELOPS SMALLEST, LIGHTEST CHEMICAL ANALYZER

PHYSICAL SCIENCES RESEARCH
BIOASTRONAUTICS RESEARCH
FUNDAMENTAL SPACE BIOLOGY
SPACE PRODUCT DEVELOPMENT

Why is it important?

Detecting trace levels of toxic chemicals before they reach harmful levels in the atmosphere is crucial to astronaut health on long missions and important for humans on Earth as well. One highly accurate and reliable tool that can quickly and automatically analyze complex mixtures of gases is the mass spectrometer. However, mass spectrometers are large, expensive devices demanding large power supplies. A handheld model was needed to monitor the environment outside the International Space Station (ISS) during spacewalks.

What is NASA doing?

Ara Chutjian and his colleagues at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA, revolutionized the mass spectrometer by developing a miniature version just 3 inches tall and weighing about 4 ounces (a world record). With its associated gear, the system weighs only 3 pounds. This new Trace Gas Analyzer (TGA) was delivered to the ISS in February 2001. It can detect leaks of ammonia from cooling systems, propellant from thrusters, and air leaks from seals and micrometeorite holes in the spacecraft structure.

What are the benefits?

The U.S. Environmental Protection Agency uses mass spectrometers to monitor contamination from Superfund sites and factory emissions on Earth. These devices are only used sparingly because of their large size and high cost, and the samples are often brought back to labs for analysis. Chutjian and his colleagues hope to make their small, inexpensive unit available for readily detecting contaminants here on Earth. They are working with Consolidated Edison to develop field-deployable prototypes to detect PCBs (polychlorinated biphenyls) at contaminated sites.

What is next?

NASA will be able to use the combined gas chromatograph-mass spectrometer (GCMS) on human missions beyond low-Earth orbit. It would constantly monitor the spacecraft's air to detect the accumulation of hazardous gases such as carbon monoxide, benzene, and formaldehyde. The device can also be used to study the chemical composition of the materials collected from a Martian or asteroid surface. Chutjian and his colleagues are designing a second-generation mass spectrometer with 50 times the sensitivity and 3 times the resolution of the current model.

JPL technologists responded to a request for a quick, low-cost innovation by creating the smallest mass spectrometer yet produced for either human or robotic space flight (above, about actual size). It is used inside a handheld tool (inset) used by astronauts to check for leaks outside the International Space Station.

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